Public Page (Abstract)

The objectives of the work are to:

- Increase pipeline safety by characterizing strain anomalies in pipes due to gouged dents in terms of the time-evolution of nonlinear harmonic (NLH) signals;
- Formulate NLH-based defect severity criteria for the remaining lives of mechanically damaged pipelines that can be used in assessing delayed failures;
- Enable NLH technology to be transferred to in-line inspection (ILI) companies through collaboration between SwRI and Tuboscope Inspection Services in developing guidelines and software for implementing the NLH-based criteria.

The intent of the program is to:

- Investigate the capabilities of the NLH method to detect simulated stress corrosion cracking by subjecting the EDM notched pipe sample to various static pressures while inspecting the inside of the sample with an NLH scanner to detect the strain anomalies on the inside surface of the pipe produced by the notches;
- Use NLH scanners to periodically monitor the development of strain anomalies on the inside of the four gouged pipe samples due to the accumulation of fatigue damage from cyclic pressure changes.

Accomplishments include completion of cyclic pressure testing and NLH inspections of four gouged pipes to detect the build-up of fatigue damage at the defects. Periodic NLH scans were performed during the cycling. Failures (leaks) were observed at ten defects. These defects were repaired to enable pressure cycling of the remaining gouges to continue. The NLH scanners measured axial and circumferential magnetic field responses (magnitudes and phase shifts) on the insides of the pipes over the full circumferences and over axial lengths of 52 inches. The NLH response signals clearly indicate the presence of the gouges on the outsides of the pipes by detecting the strain anomalies they produce on the inside surfaces. The results have been analyzed to identify changes in the signals that are related to the accumulation of fatigue damage leading to failure. It was not possible to unambiguously and consistently identify features in the NLH signals that reflect build-up of fatigue damage. However, a simple defect severity parameter based on defect dimensions has been derived. When combined with estimates of residual gouge depth and gouge length based on analysis of NLH scan results, the severity parameter appears to rank the severity of gouged dents with respect to fatigue lives.